

BREEDING EXPERIMENTS WITH *MORPHO PELEIDES INSULARIS*
(LEPIDOPTERA: NYMPHALIDAE) IN TRINIDAD, W.I.

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Abstract.—A breeding program of *Morpho peleides insularis* Fruhstorfer in Trinidad led to successful rearing of large broods of this butterfly on *Paragonia pyramidata* (Bignoniaceae). Crossing with *M. achillaena* Hübn. from Rio de Janeiro, Brazil, gave good fertility to the F₄, while crossing with *Morpho achilles* Fruhst. from Belém, Pará, Brazil did not lead to generations beyond the F₁. The appearance of melanic forms of *peleides*, which occurred on two separate occasions in captivity, was followed by means of selective breeding; this revealed that the melanism had a genetic basis but was probably also influenced by the physical environment (especially excessive sun and heat exposure of juveniles in the breeding cage), and that at least two melanic characters (and possibly three) were segregating independently.

Morpho peleides insularis Fruhstorfer, the only member of its family in Trinidad,¹ is not rare on the island. It is well distributed in all forested areas, particularly along the moist valleys and footpaths of the mountainous Northern Range (Barcant 1970). Very little study has been given to the life history of this species in Trinidad; with the exception of a paper by Stollmeyer (1932), giving details of the early stages obtained from two eggs extruded from the abdomen of a captured female, no further work has been published. Many biological data have recently been published, however, on central American *M. peleides* (Young and Muysshondt 1973; Young and Thomason 1974; Young 1974).

In January 1964, I became interested in breeding Trinidad *M. peleides* in captivity, under near-natural conditions. The following problems had to be solved initially:

a. The butterfly had never been kept alive in captivity in Trinidad; its adaptability to such a life was speculative.

b. The female was a known recluse; only a few existed in collections. It was uncertain whether sufficient numbers in gravid condition could be lured to bait, or whether they would oviposit in captivity.

¹ I have followed Fruhstorfer (in Seitz, 1907) for the nomenclature of *Morpho peleides insularis*. I consider LeMoult's application of the term *tobagoensis* [LeMoult & Real (1962)] to be a misnomer; his recording of subspecies of *M. trojana* and *M. corydon* in Trinidad is also not in accordance with fact.

c. The host plant, *Paragonia pyramidata* Rich. (Bignoniaceae) was known to only two people in Trinidad (it was incorrectly quoted in Stollmeyer's paper), and unknown to me except by vague description—"a forest wild vine with purplish young leaves and not easy to detect."

By mid-1965 these obstacles had been overcome. A fine mesh cage $10' \times 5' \times 8'$ was built; the host plant, located and planted within it, grew rapidly in leafy abundance; and "Emperor Valley" near Port-of-Spain had produced numerous gravid females caught on rotting breadfruit, all willing to lay profusely in captivity. At the end of 1965 two good broods of over 80 adults emerged and the way was open to further study. In February 1966 mating of *M. peleides* in captivity was achieved for the first time in Trinidad; this led to a successful program of breedings and crossings. Further breeding space was also added with another cage of $20' \times 10' \times 8'$.

In early 1966, a visit of Keith Brown, Jr. to Trinidad paved the way for trials in cross-breeding *M. peleides* with *M. achillaena* Hübner from Rio de Janeiro. With his help in the supply of live males from that area, these crossings were performed successfully during 1966. During the year 1967, repeated broods of local *peleides* were raised in one cage and crossing experiments with *achillaena* were continued in the other (until June). Towards the end of the year, the smaller cage was devoted to eventually successful crossings between *M. peleides* and *M. achilles amazonica* Fruhstorfer, from the lower Amazon (Belém). Although the progeny of the latter cross proved sterile, those from the *achillaena* crosses were taken through four generations. In my opinion, this offers strong evidence that *M. peleides* and *M. achillaena* are one species, with morphological differences merely the result of geographical separation, without effect on potential for interbreeding. The relation of both to Amazonian *M. achilles* must still remain an open question, in view of the negative results of the single experiment performed.

Emergence of a melanic form of M. PELEIDES.—In September 1966, during the emergence of the third brood of inbred *peleides*, three males appeared (on 20/IX, 27/IX and 29/IX) with the following characteristics:

a. Total absence of all white spots in the black forewing submarginal area of the upperside (marginal white spots were still present round the edge of both wings).

b. Total absence of red spottings and cream bands in the submarginal areas of both wings, on the underside.

I expected to get females of this melanic form in the brood, but none emerged, so I was unable to select a melanic pair for inbreeding.

An attempt was made to mate one melanic male with a normal female. This proved unsuccessful, and the event passed by with a notation, the other two melanic males being added to my collection.

No further melanic *peleides* emerged at any time during 1966–1967; it was



All specimens figured were reared in captivity at 19 San Diego Park, Diego Martin, Trinidad, and were selected from Brood 3 described in the text, between November 22, 1968 and January 10, 1969; they are now in the author's collection.

not until early 1968 that melanism again appeared in captive Trinidad *Morpho*.

In March 1968, with the host-plants fully refoliated in the now empty larger cage (after the crossing experiments), five gravid females were captured in the field and set for oviposition, with a full diet of overripe breadfruit (this sweet smelling succulent is abundant in Trinidad, and forms an ideal diet in captivity for all indigenous sugar suckers). Within a week these females had produced 200 eggs, 180 of which hatched. From this successful brood, there emerged 11 melanic males and 10 melanic females during June 2 to 25. The following points were noticeable in these specimens:

a. The males were constant among themselves and identical with the original melanic males produced in September 1966 (Figs. 6, 10).

b. The females, also constant, retained an inner submarginal row of white elliptical spots on the forewing, not as pronounced as in normal females. The outer marginal row was absent. The underside submarginal region of both wings showed the same absence of the three red and cream bands as in the male (Figs. 7, 11).

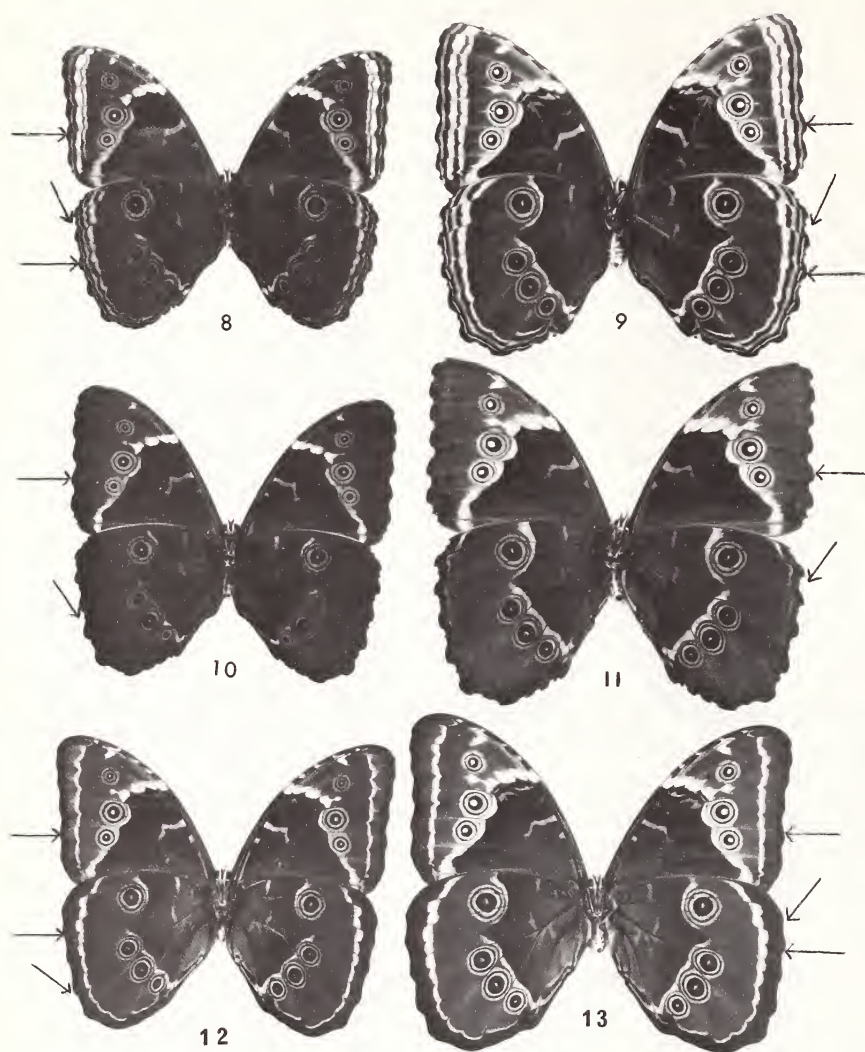
The constancy of the 21 melanic forms suggested the presence of a gene linkage of upperside submarginal white spots and underside submarginal cream and red bands. Selective breeding was carried forward successfully with the melanic individuals from this brood.

Further broods of melanic M. PELEIDES.—On June 9, 1968, four melanic males were put into the cage with four normal females. Matings took place between June 10 and June 14. On June 15, two melanic females were put in with the melanic males. Matings took place within the next two days. Unfortunately, due to space and host-plant limitations, the two groups could not be segregated, and the caterpillars were reared together, leaving a pure black selection for the third brood.

In a total of 83 adults obtained from this "joint venture," 16 (about 20%) were melanic, again constant in phenotype. Due to the mixed nature of this brood little importance can be given to this figure, but it might indicate that

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Figs. 1-7. (uppersides) Fig. 1. N—Normal male as found in the field; arrows show marginal intervenal white spots on both wings doubled on the hindwing (best noted against the light background by the deeper serrations of the wing margins), and seven submarginal white spots on the forewing. Fig. 2. N—Normal female as found in the field; arrows show marginal intervenal white spots as in the male but more pronounced, and eight submarginal spots on the FW, larger than those of the male. Fig. 3. NRS—"Semi-normal" male, with submarginal FW spots reduced to four (two faint), and intervenal spots present on both wings but not pronounced; the underside is normal. Figs. 4-5. B—Totally black female and male respectively, with both marginal and submarginal spots absent; in the female the inner discal elliptical spots are present but reduced in size. Figs. 6-7. BW—Black male and female respectively, similar to 4-5 except that the intervenal marginal spots are present as in 1-3.



Figs. 8-13. (undersides) Figs. 8-9. N—Normal male and female respectively, with three full submarginal cream and red bands. Figs. 10-11. BW—Black male and female respectively; the three submarginal bands are entirely missing except for a trace at the female HW apex. Figs. 12-13. BC—Totally black (upperside) male and female, respectively; on the underside only the inner of the three submarginal bands remains. Form BCW is similar to 12-13, but with intervenal marginal white spots present.

genetic factors were showing an influence in the appearance of the character. The 16 melanics broke evenly between the sexes and all were used for a third selective brood.

Five matings were obtained between August 31 and September 15, 1968, and egg-laying extended throughout September and the first week of October. No account can be given for the reluctance of three of the females to mate. Surprising deviations appeared in the resulting progeny, which emerged between November 22, 1968 and January 10, 1969. The six phenotypes which appeared in this brood are as follows:

- a. Normal: N (Figures 1, 2, 8 and 9)—normal *peleides*.
NRS (Figure 3)—near-normal *peleides* with forewing submarginal white spots reduced in size and number; otherwise normal with intervenal spots and all underside submarginal bands and red spottings present; this phenotype only in males.
- b. Melanic: BW (Figures 6, 7, 10, and 11)—black form with small intervenal white spots (doubled in female) on the margins.
B (Figures 4 and 5)—totally blackened form, without the intervenal white marginal spots.
BCW (not figured)—black form with white intervenal spots, and one (the inner) instead of three cream bands in the submarginal area of the underside; red spottings absent.
BC (Figures 12 and 13)—same as BCW but intervenal marginal white spots absent.

The following chart indicates the numbers obtained for each phenotype:

Phenotype	Male	Female	Total	
N	30	44	74	} Normal (69%)
NRS	18	—	18	
BW	11	6	17	} Melanic (31%)
B	9	5	14	
BCW	1	2	3	
BC	3	5	8	
Totals	72 (57%)	62 (43%)	134	

The percentage of melanism increased to 31% in this second selective breeding. While the submarginal spots of the forewing upperside and the two outer submarginal bands of the underside were always absent in the

melanic types produced, two types of deviations appeared in the presence or absence of intervenal white marginal spots (W) and the third (inner) cream band on the underside (C). Total disappearance of red from the underside marginal area was observed in all the melanic forms.

The normal cream and red marginal bands expressed themselves as 27% with a single cream band (the inner of the three; BC) and 73% with all three bands completely absent (B). The intervenal white spots divided nearly equally between present (BW, 48%) and absent (B, 52%). The fact that the two characters can be absent together (33%), individually present (W = 41%, C = 19%), or present together (CW = 7%), indicates independence of segregation of the respective genes concerned with cream underside bands and white intervenal spots.

At this stage, it would have been desirable to have unlimited space and host plant available to carry on a growing number of possible combinations. Unfortunately this could not be done, but a fourth brood was obtained on very limited food supply from matings between BW pairs, with the following results:

Phenotype	Male	Female	Total	
B + BW	8	6	14	} Melanic (50%)
BC + BCW	4	1	5	
N	<u>12</u>	<u>7</u>	<u>19</u>	} Normal (50%)
Totals	24 (63%)	14 (37%)	38	

The brood was a small one, and an attempt to score the intervenal spots versus bands was not made, but it may be noted that the single cream band (C) in melanics was again present at 26%.

Due to a change in my residence and the consequent disruption of the breeding experiments, the program had to be discontinued at this stage.

Conclusions and Discussion

I realize that these initial experiments have only scratched the surface of the phenomenon of melanism in Trinidad *M. peleides*; in the absence of more detailed selections and further broods, under controlled environmental conditions, definite conclusions are difficult to make. The evidence from the four broods does indicate, however, that:

- Melanism does occur, potentially, in Trinidad *peleides*, although it has never, to my knowledge, been recorded in the field; it was discovered for the first time in breeding experiments in September 1966.
- Genetic factors play a predominant role in the expression of melanism in Trinidad *peleides*: it seems probable that a 100% pure melanic strain could be developed by repeated selective breeding.

- c. Selective breeding does bring out more than one expression of melanism, with varying combinations of the presence or absence of the three normal pattern features.
- d. Morphologically, in habits and in lifespan, the early stages of the melanic *peleides* are identical to those of the normal form.

In the absence of more detailed experiments, the initial cause for the development of melanism in the captive populations can only be speculative. In the face of a 10% development in the first brood, from normal parents obtained directly in the field, where the phenomenon has not been recorded, it is necessary to consider that the color modification may be due to environmental stress under captive conditions.

In all the broods, it was observed that the host plant climbing against the mesh roof of the cage was mostly sparse in growth, not only letting through sunlight but in many areas having only a single thin layer of older leaves exposed to the direct rays of the sun. Caterpillars which in the field would invariably be well shaded by thick overhead forest growth throughout their five instars, therefore found themselves exposed to a much higher degree of direct sunlight than they would normally experience. In many cases, they found large leaves at lower levels on the sides of the cage, where they could be sheltered under more normal conditions of temperature and shade, but some persisted at higher levels near the roof of the cage. In the heat of the day, these could be seen hanging downwards by their hind pair of fleshy prolegs, possibly in response to heat stress or to escape the high temperature and sun's rays which were penetrating and heating the leaves below which they had been resting.

It is possible that the existence of such abnormal conditions of heat and light during the first four instars, perhaps to a lesser degree in the fifth when the caterpillars became gregarious and hid along the stems of the vine, but also in the pupal stage when they were often on the cage roof again (though in seclusion), could affect the expression of some genes controlling the marginal spots and underside bands, and that this effect could be continued increasingly by selective breeding in successive generations.

The proportional numerical increase in melanic emergence through selective breeding suggests that recessives, normally obscure in the field, were concentrated in the later broods, though their expression may also have been triggered by abnormal environmental conditions. It is difficult, however, to propose a mechanism whereby additional heat, sunlight and exposure could promote melanism in the adults.

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